

in which the petrosal bone subsequently makes its appearance. Near its proximal end, the rod-like "mandibular cartilage" sends off another slender cartilaginous process, which extends forwards parallel with the base of the skull. With the progress of development, ossification takes place in the last-named cartilage, and converts it, anteriorly, into the palatine, and posteriorly, into the pterygoid bone. The mandibular cartilage itself becomes divided into two portions, a short, proximal, and a long, distal, by an articulation which makes its appearance just below the junction of the pterygo-palatine cartilage. The long distal division is termed, from the name of its original discoverer, Meckel's cartilage. It lengthens, and an ossific deposit takes place around, but, at first, not in it. The proximal division in the mammal ossifies, but usually loses its connexion with the pterygoid, remains very small, and becomes the incus. In the bird the corresponding part enlarges, ossifies, and becomes the os quadratum, retaining its primitive connexion with the pterygoid. In the mammal, the proximal end of Meckel's cartilage ossifies and becomes the malleus, while the rest ultimately disappears. The ossific mass which is formed around Meckel's cartilage remains quite distinct from the proximal end of that cartilage, or the malleus, gradually acquires the form of the ramus of the lower jaw, and

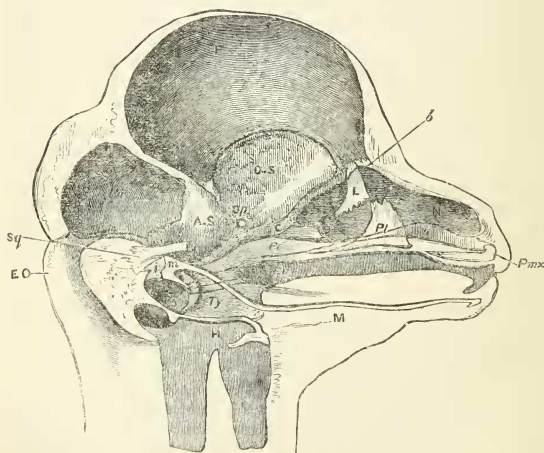


Fig. 3.—Dissection of the cranium and face of a fetal lamb 2 inches long. The letters have the same signification as elsewhere, except N. Nasal capsules. *a. b. c.* Septum narium. *L.* Lacrymal. *Pl.* Palatine. *Eu.* Arrow indicating the course of the Eustachian tube. *i.* Incus. *m.* Malleus. *M.* Meckel's cartilage. *H.* Hyoid. *Ps.* Petrosal. *Ty.* Tympanic.

eventually develops a condyle which comes into contact, and articulates, with the squamosal. In the bird, on the contrary, the ramus of the jaw unites with the ossified proximal end of Meckel's cartilage, which becomes ankylosed with the ramus; but retaining its moveable connexion with the quadratum (or representative of the incus), receives the name of the articular piece of the jaw. The rest of Meckel's cartilage disappears.

Thus the primitive composition of the mandibular cartilaginous arch is the same in the bird as in the mammal; in each, the arch becomes subdivided into an incudal and a Meckelian portion; in each, the incudal and the adjacent extremity of the Meckelian cartilage ossify, while the rest of the cartilaginous arch disappears and is replaced by a bony ramus deposited round it. But from this point the mammal and the bird diverge. In the former, the incudal and Meckelian elements are so completely applied to the purposes of the organ of hearing, that they are no longer capable of supporting the ramus, which eventually comes into contact with the squamosal bone. In the latter, they only subserve audition so far as they help to support the tympanic membrane, their predominant function being the support of the jaw.

The tympanic bone of every mammal is, at first, a flat, thin, curved plate of osseous matter, which appears on the outer side of the proximal end of Meckel's cartilage, but is as completely independent of it as is the ramus of the jaw of the rest of that cartilage. In most birds it has no bony representative.

It is clear, then, as Professor Goodsir\* has particularly stated, that the os quadratum of the bird is the homologue of the incus of the mammal, and has nothing to do with the tympanic bone; while the apparently missing malleus of the mammal is to be found in the os articulare of the lower jaw of the bird.

It would lead me too far were I to pursue the comparison of the bird's skull with that of the mammal further. But sufficient has been said, I trust, to prove that, so far as the cranium proper is concerned, there is the most wonderful harmony in the structure of the two, not a part existing in the one which is not readily discoverable in the same position, and performing the same essential functions, in the other. I have the more willingly occupied a considerable time in the demonstration of this great fact, because it must be universally admitted that the bones which I have termed petrous, squamosal, mastoid, quadratum, articulare in the bird, are the homologues of particular bones in other oviparous *Vertebrata*, and consequently, if these determinations are correct in the bird, their extension to the other *Ovipara* is a logical necessity. But the determination of these bones throughout the vertebrate series is the keystone of every theory of the skull—it is the point upon which all further reasoning must turn; and therefore it is to them, in considering the skulls of the other *Ovipara*, that I shall more particularly confine myself.

\* Reichert, however, had already clearly declared this important homology in his 'Entwicklungsgeschichte des Kopfes,' p. 195.

*Composition of the Skull of the Turtle.*

It has been seen that in birds the presphenoid, ethmoid, and orbitosphenoid regions are subject to singular irregularities in the mode and extent of their ossification. In the turtle, not only are the parts of the cranium which correspond with these bones unossified, but its walls remain cartilaginous for a still greater extent. In fact, if a vertical section be made through the longitudinal axis of a turtle's skull, it will be observed that a comparatively small extent of the cranial wall, visible from within, is formed by bone, and that the large anterior moiety is entirely cartilaginous and unossified. The anterior part of the posterior, bony, moiety of the cranial wall is formed by a bone (Pt.), whose long, vertical, anterior-inferior margin forms the posterior boundary of the foramen by which the third division of the trigeminal nerve makes its exit from the skull. The anterior and superior margin of the bone is very short, and articulates with the parietal bone. The superior margin is inclined backwards, and articulates with the supraoccipital. The posterior margin is straight, and abuts against a cartilaginous plate interposed between this bone and that which succeeds it. The inner face of the bone is, as it were, cut short and replaced by this cartilage, whence the inferior edge is also short and is connected only with the basisphenoid, and not with the basioccipital. The anterior margin of the bone corresponds with the middle of the mesencephalon, while its inner face presents apertures for the portio dura and portio mollis. The posterior margin of its outer face forms half the circumference of the fenestra ovalis, and it contains the anterior and inferior portions

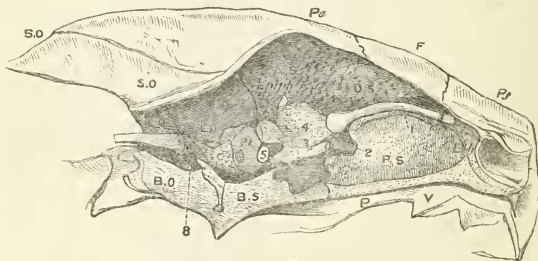


Fig. 4.—Longitudinal section of the Skull of a Turtle (*Chelone mydas*), exhibiting the relations of the brain to the cranial walls. The dotted parts marked AS. OS. PS. and Eth. are cartilaginous.

of the labyrinth. Thus, with the exception of the absence of an inferior connexion with the basioccipital,—a circumstance fully explained by the persistence in a cartilaginous state of part of the bone,—it corresponds in the closest manner with the petrosal of the bird. I confess I cannot comprehend how those who admit the homology of the bone called petrosal in the bird with that called petrosal in